



Mike Richards G4WNC's Data Modes

PW Publishing Ltd., Tayfield House, 38 Poole Road, Westbourne, Bournemouth BH4 9DW
E-Mail: mike@pwpublishing.ltd.uk

Arduino

The Experimenter's Friend

Mike Richards G4WNC has an interesting Arduino project that will not only be useful in the shack but will also teach you something about this increasingly useful device.

I'm off on a totally different tack this month because I'm taking a look at a great new way to play with Arduino boards along with a simple project to build a rotary volume control for your SDR radios.

The Arduino range of microcontroller boards has been around since 2005 and provides just about the easiest way to build a microcontroller into any project. Most of the boards are self-contained with their own power regulator, a USB port and two lines of sockets for making external connections. The current standard board is the Arduino Uno R3, **Fig. 1**, that sells for just under £20. You can program the board using a simplified version of the C language. This is very easy to learn and there are examples and libraries available for just about anything you want to do. To use the code, you first need to download the Arduino Integrated Development

Environment (IDE), which is completely free and available from the Arduino website.

<http://arduino.cc>

The website also has many examples that you can download and experiment with. There are lots of tutorials around but the one at the end of this paragraph has been put together by **Limor Fried** who is the founder of Adafruit. These tutorials are all very hands-on and you can upload the code to your board as you progress and see things happen. This is a great way to learn programming. When you move on to your own projects, you will find there are a huge number of pre-written libraries designed to make life simple. These libraries are easy to add to your project and contain all the coding necessary to do more complex tasks such as sending data over an SPI connection, driving a stepper motor,

reading a temperature sensor and so on.

www.ladyada.net/learn/arduino

Because the Arduino boards are so versatile, lots of manufacturers have started producing Arduino clones or adaptations to meet different needs. One of the most popular adaptations is the Arduino shield. This is an accessory board that plugs into the connectors on the Arduino and sits on top rather like a shield. These shields provide all manner of extra functions. For example, the Motor shield has an LM298 high power motor driver chip and it can be used to drive robot motors or powerful stepper motors, **Fig. 2**. There are lots of shields out there and they can be a quick way to include all the hardware necessary for your project.

In addition to a wide range of shields, there are many Arduino processor boards designed to cover all manner of situations. Some give the Arduino more processing power using the same Arduino IDE while others are minimal versions of an Arduino board that aim to keep the cost down and are great for many simple projects. The board that I want to highlight this month is the Adafruit Trinket, **Fig. 3**. Adafruit are a young New York based company that specialise in designing and manufacturing products for the Maker or hobbyist market. They have a huge range of products available and their prices are very friendly. They developed the Trinket about a year ago and the few minor software snags have now been ironed out. As you can see from the photos, the Trinket is tiny and very easy to lose! At the heart of the board is an Atmel ATTiny85 microcontroller that does all the hard work. Being so tiny, there are just five input/output pins but that is often enough for many projects. The Trinket has a USB port for easy programming and despite its small size, a power regulator is included that can be used to supply up to 150mA to the rest of your project. The Trinket comes in two versions with either a 3.3 or 5V supply. Other than the fact that the 5V version can run at 16MHz rather than 8MHz, you choose your Trinket based on the voltage requirements of other items in your project. At just under £7 including VAT, these boards are a real bargain.

The only drawback with the Trinket boards has been the requirement to

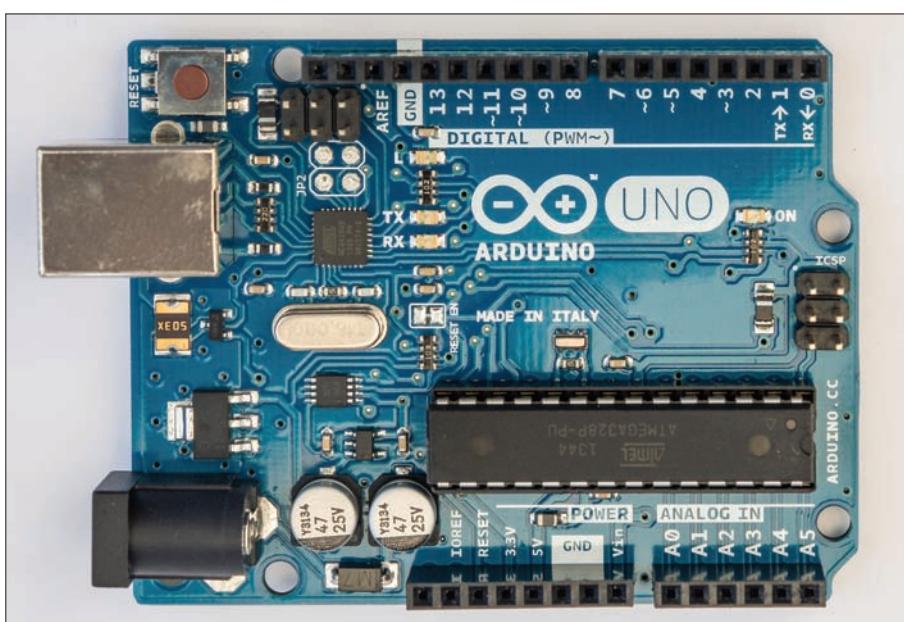


Fig. 1: Arduino Uno – the standard Arduino board.

download an adapted version of the Arduino IDE, **Fig. 4**. Although not too onerous, some people were put off by this and the fact that early versions didn't have signed drivers available for 64-bit Windows 8. However, that's all in the past and signed 64-bit drivers are now available from Adafruit. Even better news comes with the introduction of the Codebender online Arduino IDE. Codebender is a completely free service that provides an Arduino IDE accessible via the internet using any of the popular web browsers, **Fig. 5**. What makes it particularly appropriate is that the IDE has the Trinket boards and lots of other Arduino clones already integrated. Codebender also has many of the common Arduino libraries pre-installed and they will install others on request. I dropped them an e-mail asking for the Trinket USB libraries to be included and they were added the next day.

Codebender – Getting Started

Assuming that you have your hands on a Trinket, the first thing to do is to install the Trinket USB driver. Start by downloading either the Windows 8 or XP/7/Vista drivers as appropriate for your system from the Adafruit site below.

<http://goo.gl/xOKuRb>

Now unzip the downloaded file to a convenient folder and connect your Trinket to a free USB port. The next window you see depends on the Windows version you're running but you want to get the New Hardware wizard to look in the folder you just expanded for the driver. If you miss this and the PC complains that it can't find a suitable driver, don't panic. Open up Control Panel and you should see an unrecognised device, which is your

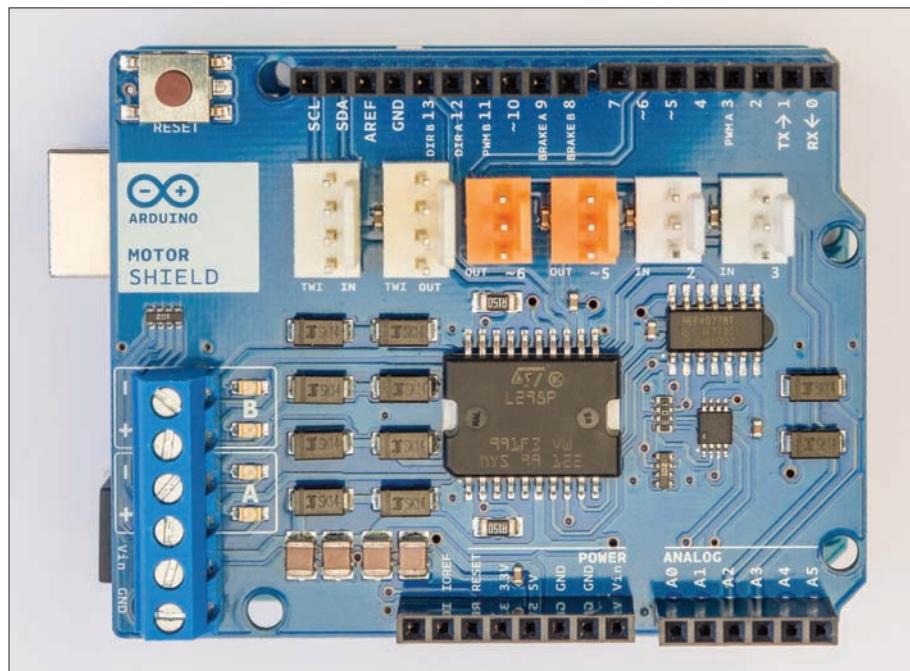


Fig. 2: The Arduino motor shield.

Trinket. Right-click on the Trinket entry and choose update driver. Now you can steer Windows to look in the correct folder for your downloaded driver and all should be fine. When the driver installation is complete, the Trinket will appear in Device Manager as a USBtiny device under the LibUSB-Win32 entry. The Trinket, like all Arduino boards, is supplied programmed with a bootloader. This is special code that is used to allow programming of the Arduino board over the USB connection. To put a Trinket board into bootloader mode, you have to press the Trinket's reset that you'll find on the PCB, **Fig. 6**. Shortly after pressing the reset, you should see that the red LED starts flashing for about ten seconds. You need to remember to do this whenever you try to upload a program to your Trinket.

The next step is to visit the Codebender website and choose Sign-up. The service is free and once complete, you should be taken through the getting started process that will also install the Codebender extension into your browser. While doing this, you will need to have your Trinket connected because some test code is passed to the Trinket to make sure everything works correctly. At the end of that process you're ready to start programming.

<http://codebender.cc>

SDR USB Volume Control

While I love the point and click tuning employed by most SDR receivers, I'm not so keen on the click and drag volume controls because they seem a bit cumbersome to me. When you

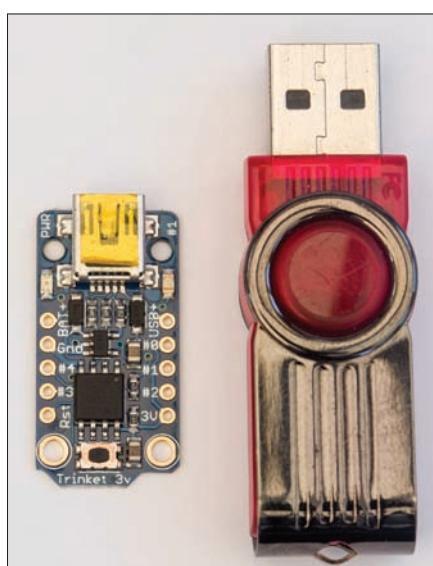


Fig. 3: The tiny Adafruit Trinket shown with a standard USB stick.

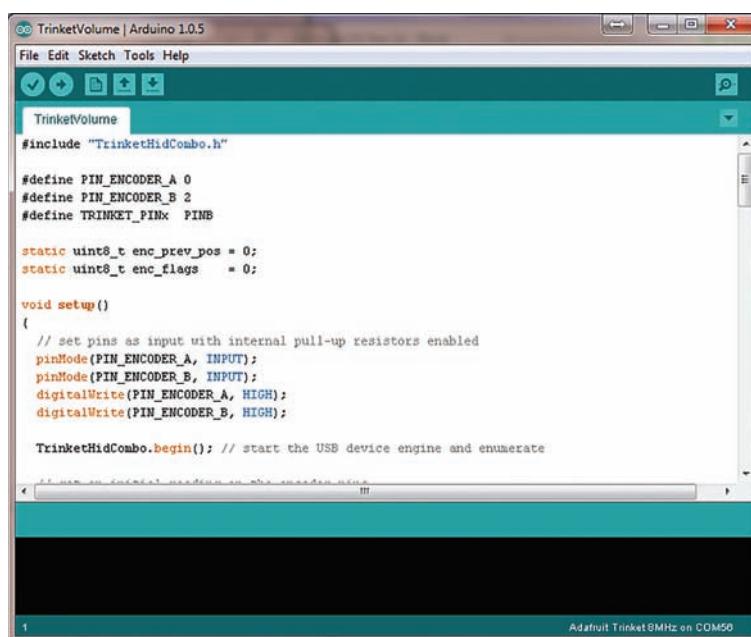


Fig. 4: The Arduino IDE.

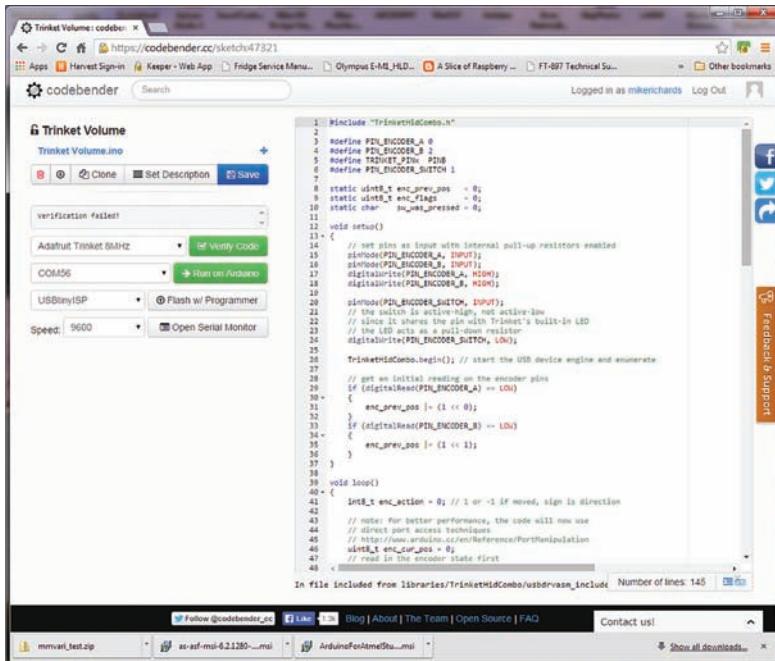


Fig. 5: The Codebender IDE.

change bands and need to alter the volume quickly, it seems to take an age to find the control and turn it down. However, I have recently found a solution that uses the Adafruit Trinket board to create a neat USB volume control knob. One of the great things about Adafruit is they always provide an excellent range of examples to help you get the best from their hardware. The examples are always very well documented with simple breadboard layouts and all the code you need. The USB volume control project is one such example for the Trinket and is ideal for use as an SDR receiver volume control. All you need is a Trinket board, a rotary shaft encoder and a USB cable, **Fig. 7**.

Building the USB Volume Control

In order to program your Trinket, you first

need to install the modified Arduino IDE that is available from Adafruit. This is easily done and involves downloading a zip file and expanding it into a directory of your choice. Below is a link to the tutorial (just click the appropriate link for 'The Quick Way').

<http://goo.gl/vp4To9>

The next step is to download and install the Trinket driver as I described earlier. That completes the configuration of your programming environment so you are now able to get the code for the USB volume control. The full description of the project can be found via the link below.

<http://goo.gl/qrRsar>

The web page takes you gently through all the steps to wire up and program your Trinket board. One common mistake is to forget to press the reset button on the Trinket before



Fig. 6:
Trinket reset.



uploading the software. If you don't do this, you will get an error report and the code won't upload. You will note that the project uses a shaft encoder to convert the rotary movement of the knob into a digital format. The technique employed is very simple and uses quadrature signals. As you turn the shaft, on/off pulses are produced from the A and B terminals but the pulses are 90° out of phase, which corresponds to a quarter of a cycle (360°), hence the term quadrature. When you turn the shaft clockwise, the B signal leads the A signal but when turned in the opposite direction, the A signal leads the B, **Fig. 8**. This characteristic is used by the software to determine the direction of shaft rotation, while the number of pulses is used to measure how far the shaft has rotated. Most of the cheaper shaft encoders employ 12 or 24 pulses per revolution. On my system, a shaft encoder with 24 clicks per revolution took two turns to move the volume between its extremes.

When choosing your shaft encoder, you will find that most have click detents but there are a few out there that employ a continuous action. Most of the popular electronics hobbyist shops sell suitable rotary or shaft encoders for around £3 each.

Using the Control

The USB volume control is recognised by Windows as a Human Interface Device (HID) and operates on the Windows Mixer volume control. You will find the icon for this in the bottom right of the screen. To make the best use of the USB volume control, you need to make sure the volume sliders on your SDR receiver are turned up

so that you rely on the Windows Mixer for the main volume control. The USB volume control works for all sound passing through the PC so you can use it for other applications. Now all we need is a design for a Trinket-driven tuning knob!

Fig. 7: This is all you need to build a USB volume control.

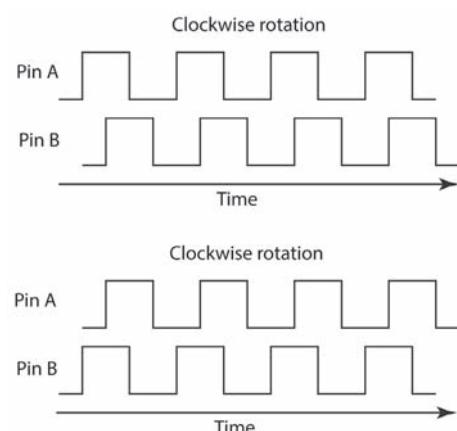


Fig. 8: An illustration of quadrature signals from a rotary encoder.